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ABSTRACT

This document presents a cognitive diagnostic test which was devised as part of the Multilevel Remediation in Biology, Chemistry and Mathematics project funded by the Fund for the Improvement of Postsecondary Education (Department of Health, Education, and Welfare). The test diagnoses the following areas of cognition judged by empirical analysis and/or substantiated by statistical analysis to be necessary for successful completion of college-level courses: Verbally Defined Language, Visual-Abstract Language, Pattern Recognition, Classification, and Logical Interaction. Although correlations vary with teaching style and maintenance of standards within courses, the general trend is for positive correlations between all segments of the test and students' final grades. Correlation coefficients between students' grades vs. segments of the test, and grades vs. reading scores indicate that the Cognitive Diagnostic Test is the better predictor of success in course work, particularly in classes where thinking is an explicit learning objective and in which standards are criterion-referenced. (Author/RH)

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FINAL REPORT

MULTILEVEL REMEDIATION IN BIOLOGY, CHEMISTRY
AND MATHEMATICS

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MULTILEVEL REMEDIATION IN BIOLOGY, CHEMISTRY AND MATHEMATICS

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7/1/77	6/30/78	12	\$43,459.00
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8/1/75	6/30/76	11	\$41,000.00

ABSTRACT

A cognitive diagnostic test was devised as part of the Multilevel Remediation in Biology, Chemistry and Mathematics project funded by the Fund for the Improvement of Post-secondary Education (HEW). The test diagnoses the following areas of cognition judged by empirical analysis and/or substantiated by statistical analysis to be necessary for successful completion of college level courses: Verbally Defined Language, Visual-Abstract Language, Pattern Recognition, Classification, and Logical Interaction. Although correlations vary with teaching style and maintenance of standards within courses, the general trend is for positive correlations between all segments of the test and students' final grades. Correlation coefficients between students' grades vs. segments of the test, and grades vs. reading scores indicate that the Cognitive Diagnostic Test is the better predictor of success in course work, particularly in classes where thinking is an explicit learning objective and in which standards are criterion referenced.

EXECUTIVE SUMMARY

The Multilevel Remediation in Biology, Chemistry and Mathematics project at the downtown campus of Jefferson Community College in Louisville, Kentucky was based on the premise that there are identifiable cognitive skills requisite for successful completion of freshman level science courses. The project was designed to develop a cognitive model and a cognitive diagnostic test to ascertain the skill levels of students with respect to the model. Cognitive skill remedial programs were developed in accordance with the model to remediate students deficient in the requisite skills. Basic biology, chemistry and mathematics programs were produced in audio-tutorial and/or CAI mode to provide the student with basic information once cognitive remediation had been achieved. Finally, Course Level biology, chemistry and mathematics audio-tutorial programs were either produced or purchased to enable students to maintain class level while taking remediation.

The emphasis of the project was the cognitive model. Instructors involved in the project developed and refined a list of cognitive skills required for individual topics in the respective courses, and questions were designed for each skill. The initial Cognitive Diagnostic Test was administered to approximately 300 students. The data analysis indicated some basic problems with the design of the instrument, and the test was revised. The second form of the test was administered to 502 students. Analysis of the data by factor analysis led to the grading categories of Pattern Recognition, Classification and Elementary Logic and Logical Interaction. These three fall under the general heading of Reasoning. The language in which the questions are asked, and in which the answers are expected was deemed sufficiently important to include two nonstatistically validated categories for grading: Verbally Defined Language and Visual-Abstract Language. These five categories became the major divisions of the cognitive model under the headings of Reasoning and Language respectively.

Requests were sent to instructors throughout the college to administer the test to their classes. At the end of the semester, final grades received by students in these classes were added to the data bank. The Spearman correlation coefficient data analysis of the results indicates that the Cognitive Diagnostic Test serves as an excellent predictor for success in college level courses, particularly in those classes where instructors use criterion referenced testing and/or teach thinking as an explicit learning objective.

The cognitive skills determined to be necessary for success in freshman level science classes were fit into the cognitive model. Students obtaining less than 60% on a section of the Cognitive Diagnostic Test are required to take the audio-tutorial programs for the skills listed under that heading.

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The efficacy of the remedial programs has been tested by using the Cognitive Diagnostic Test as a pre-test to determine needs and as a post-test to determine the degree of remediation of those needs. (Students are not primed for answering specific questions on the test. Only the reasoning processes are the same, and these are often required in different combinations than those practiced during specific programs). The data shows that students generally improve about 20% on each section. The greatest percentage of students improved on the Verbally Defined Language and Pattern Recognition subcategories, and the least improved on the Logical Interaction section of the test.

Early in the project it was found that students requiring remediation in more than one of the major heading areas could not effectively complete cognitive skill remediation and course level work within the same semester. Accordingly, students in this situation are advised to withdraw from the science course and spend the semester taking cognitive skill remediation before attempting the college level course.

Basic biology, chemistry and mathematics programs and the Course Level biology, chemistry and mathematics programs were completed or purchased. The cognitive skill aspects of the program became so time consuming, that adequate testing of these programs has not been completed. Sufficient evidence has accumulated, however, to state that only programs covering conceptually difficult information are used with any regularity and that audio-tutorializing whole courses is of limited value.

The project operated and indeed, still operates under institutional support, in the Natural Science Learning Laboratory. The philosophy operative in the Learning Laboratory is of "planned intervention". Students interact regularly and at planned intervals with the Learning Laboratory personnel.

Thus far, two publications have been published based on the project.

Korn, Ellen Improving Reasoning Skills in Nonmajor Biology Classes, Community College Frontiers, Vol 6 (4) pp.36 - 40.

Korn, Ellen Course Content and Cognition: It Isn't Either-Or, Liberal Education, Vol LXIV (4) pp. 505 - 508.

Other papers on the Cognitive Diagnostic Test and the efficacy of the cognitive skill remedial programs are in progress.

PROJECT OBJECTIVES

The Multilevel Remediation in Biology, Chemistry and Mathematics project was designed with the following objectives:

1. To determine the cognitive skills required in freshman level biology, chemistry and mathematics courses.
2. To design a cognitive diagnostic test for these skills.
3. To design and produce audio-tutorial programs to remediate these skills.
4. To design computer tests to determine the degree of acquisition of these skills.
5. To design diagnostic tests for basic biology, chemistry and mathematics information prerequisite for freshman level courses in these subjects.
6. To design audio-tutorial programs for basic biology and chemistry.
7. To design computer programs for basic arithmetic information.
8. To design and produce audio-tutorial programs for course level information in introductory biology and chemistry courses.
9. To open a Natural Science Learning Laboratory in which the project would operate.
10. To keep student records and analyze data generated to judge the efficacy of testing and remedial programs.
11. To disseminate the information and materials from the project.

A RETROSPECTIVE VIEW

There have been relatively few changes in the original plan with respect to the priority of objectives and the means of achieving them. The premise on which the project was based was that there were identifiable cognitive skills requisite for successful completion of freshman level biology, chemistry and mathematics courses, and that these requisite skills may be necessary for all college level work.

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As the project progressed, the emphasis on the cognitive skill requisites increased, while the emphasis on the other aspects diminished. For example, the objectives pertaining to the diagnostic tests for subject matter were completed in only a cursory fashion as more time and attention were drawn to the cognitive skill aspects of the project.

The renewed emphasis on the cognitive skills led to a refinement and clarification of the philosophical basis of the project. The project was viewed as operating on a foundation of two interrelated philosophies, (1) the pedagogical attitudes of those faculty members involved, and (2) the general features of the Piagetian classification. The pedagogical attitudes relate to the teaching of thinking and the premise that the real value of education is in the acquisition of methods of information processing. In tune with this is the establishment of course goals that relate factual information to the means by which the information is processed. The Piagetian classification aids in defining the starting point of the student. The goals of individual courses remain unchanged, only the means of achieving those goals are altered. Thus, the multilevel approach was to provide a means of taking the student from his/her starting point to the goal established for the course.

Another area of refinement and clarification affected by the emphasis was the classification of cognitive skill areas. In the original proposal the cognitive skill areas were classified as "basic" and "advanced". As the data accumulated it became obvious that those cognitive skill areas classified as "basic" were, in reality, language skills, while those classified as "advanced" were reasoning skills. We have changed the reference to Language and Reasoning, and use these as headings for the major divisions of the proposed cognitive skill model.

In terms of the more practical aspects of the project, the design was somewhat unrealistic. For example, the time for completion of the determination of the requisite cognitive skills, the design and production of audio-tutorial programs for cognitive skill remediation was grossly underestimated. Completion of the production required additional personnel, including a production coordinator and artists, who were not anticipated in the original proposal.

On the other hand, while the time and effort put into design and production of the audio-tutorial programs for course level biology was underestimated, the value was overestimated. Some of these programs enjoy continued use, particularly those covering conceptually difficult material. Most of the programs, however, are rarely if ever used. The efficacy of audio-tutorializing all materials in a course appears to be of limited value as students prefer the one-to-one relationship with an instructor if the option is available.

FULFILLMENT OF THE OBJECTIVES

In several cases the objectives are interrelated and cannot be meaningfully discussed separately.

Objective 1. To determine the cognitive skills required in freshman level biology, chemistry and mathematics courses.

Objective 2. To design a cognitive diagnostic test for these skills.

The determination of a cognitive model was through both empirical and statistical means. A list of cognitive skills necessary for each topic covered in freshman level biology, chemistry and mathematics courses was generated by empirical analysis by the instructors in the respective courses. This list became the basis for the design of both the Cognitive Diagnostic Test and the remedial programs (see Table 1). The validity of the cognitive model was, therefore, intimately related to the validity of the Cognitive Diagnostic Test.

The Cognitive Diagnostic Test was designed to serve large numbers of students with reading levels from 6th to 10th grade. A multiple choice format was selected for ease in grading, and the test is short enough for students to complete within 30 - 45 minutes in an untimed situation. Questions were designed for each skill area. The questions pertain to general information and all necessary facts for answering are given, thereby limiting the test to information processing skills.

The Cognitive Diagnostic Test has, in the past two years, undergone a series of revisions based on collected and analyzed data. Initially, an attempt was made to represent each area on the list by a series of questions. This proved impractical for two reasons; (1) because the number of questions necessary to represent each of the cognitive skill areas on the list for validation would have made the test too long, and (2) because it is impossible to have a single question represent a single cognitive skill.* At a minimum, a question represents the means by which the question is asked, the means by which the question must be answered and the process involved in obtaining the answer. For example, a question may be asked in verbally defined language and the answer may be expected in the same language, but the process involved in obtaining the answer may be pattern recognition. Thus, two skills would be required to answer the question. More complex questions may be asked in

*McBer Inc. Boston, Mass. did the initial statistical analysis on an early form of the Cognitive Diagnostic Test.

Table 1.

**COGNITIVE SKILL MODEL AREAS
and associated
Cognitive Skill REmedial Programs**

VERBALLY DEFINED LANGUAGE

Verbally Defined Language
Search Process for Words
Word Construction

VISUAL-ABSTRACT LANGUAGE:

Visual Language
Abstract Language
Simple Visual Relationships

PATTERN RECOGNITION

Elementary Sorting Processes
Elements of Discovery
Search Process for Patterns
Systematic Sorting Processes
Complex Visual Relationships
Coupling Words and Patterns

CLASSIFICATION AND ELEMENTARY LOGIC

Generalities and Specifics
Recognition of Argument, Justification and Proof
Identification of Inference
Recognition of Presupposition
Recognition of Implication

LOGICAL INTERACTION

Complex Relationships of Words and Patterns
Diagram, Flow Chart and Graph Interpretation

verbally defined language, but require visual-abstract language for interpretation and one or two other skills for processing.

Both problems were solved by grouping the cognitive skills into categories and using the questions in more than one of the major categories for grading. Questions that 78% of the students answered correctly were eliminated from the analysis as they did not sufficiently discriminate between students with and without skill problems. The remaining questions were submitted to a Spearman correlation coefficient analysis.* Spearman's rho is a nonparametric correlation, indicating that no assumptions are made about the distribution of cases. This method uses ordinal levels of measurement and a large number of categories on each of the variables and assumes that few cases are identical.

Using this method, fourteen question groups were generated. All groups were internally consistent and had several questions in common. The groups selected for further analysis were those that (1) represented the greatest cross section of questions on the test and (2) that could be assigned some description by empirically viewing the inclusive questions. Three groups were chosen on the basis of this statistical analysis: Pattern Recognition, Classification and Elementary Logic and Logical Interaction.

The variable of language in which a question was asked was deemed sufficiently important to entertain the idea of including non-statistically validated categories. Questions asked in verbally defined language and in visual-abstract language were grouped respectively. A variety of different processing skills are included in these groups. These skills are evidently of sufficient difference to preclude a high statistical correlation.

The data from the original fifty-nine question test, with nondiscriminating questions eliminated, was subsequently submitted to a factor analysis based on the Spearman rho for further validation. The three statistically validated categories already chosen were shown to contain essentially the same questions as the previous analysis. In addition, two other question groups were generated, with insufficient numbers of questions to be used at the present time, (see Table 2).

*Dr. Brian Daly, Institutional Research Coordinator for Jefferson Community College directed and oversaw the data analysis.

Table 2. Factor Analysis of Cognitive Diagnostic Test*

Question #	Factor 1 Pattern Recognition	Factor 2 Classifi- cation and Elementary Logic	Factor 3 Logical Interaction
2	0.3629	0.6414	
4	0.5969		
5	0.4148	0.4031	
6	0.4973		
7	0.5532	0.5153	
8	0.4521	0.3747	
9	0.4886		
10			0.4266
11		0.3148	
12	0.3485	0.4644	
13	0.4492	0.3651	
14	0.3480	0.4666	
16	0.4420		
17	0.5318		
18	0.3892	0.8646	
19	0.4069	0.8989	
20	0.3721	0.8451	
23			0.6661
24	0.5192		
26	0.3791		
28	0.3688		
29	0.3372	0.3440	
30	0.4629	0.3760	
32	0.4457		0.5706
33			0.7700
34		0.4687	0.4301
35	0.3004	0.3032	0.4431
36	0.6765		0.1087
37	0.5168		
38	0.3574	0.3796	0.5334
39	0.3917		0.4770
40			0.3788

*Spearman Correlation Coefficients

The five groups on which the test is presently graded, and on which the cognitive model is based are:

LANGUAGE

I. Verbally Defined Language (empirical) 23 questions

The ability to defined words in terms of other words.

II. Visual-Abstract Language (empirical) 21 questions

The ability to produce mental images in response to verbiage or symbols and to relate symbols to real objects or to one another.

REASONING

III. Pattern Recognition (statistical) 26 questions

The ability to recognize verbal and/or visual patterns and perceive relationships expressed in these patterns.

IV. Classification and Elementary Logic (statistical) 14 questions

The ability to perceive generalities and specifics and place information into appropriate categories.

V. Logical Interaction (statistical) 10 questions

The ability to draw logical conclusions from word and visual-abstract relationship problems.

The test consists of a total of 40 questions, each graded on at least two parameters. There are three questions of the forty that are not scored and are on the test only to give confidence to students taking the examination. An additional six questions are new, and are presently included in scoring only for the empirically derived categories. These will be added to appropriate categories when sufficient statistical information is available. (See Enclosure A).

The empirically developed list of cognitive skills requisite for successful completion of biology, chemistry and mathematics courses were then fit into the categories generated by analysis of the Cognitive Diagnostic Test (See

Table 3. PROPOSED COGNITIVE MODEL

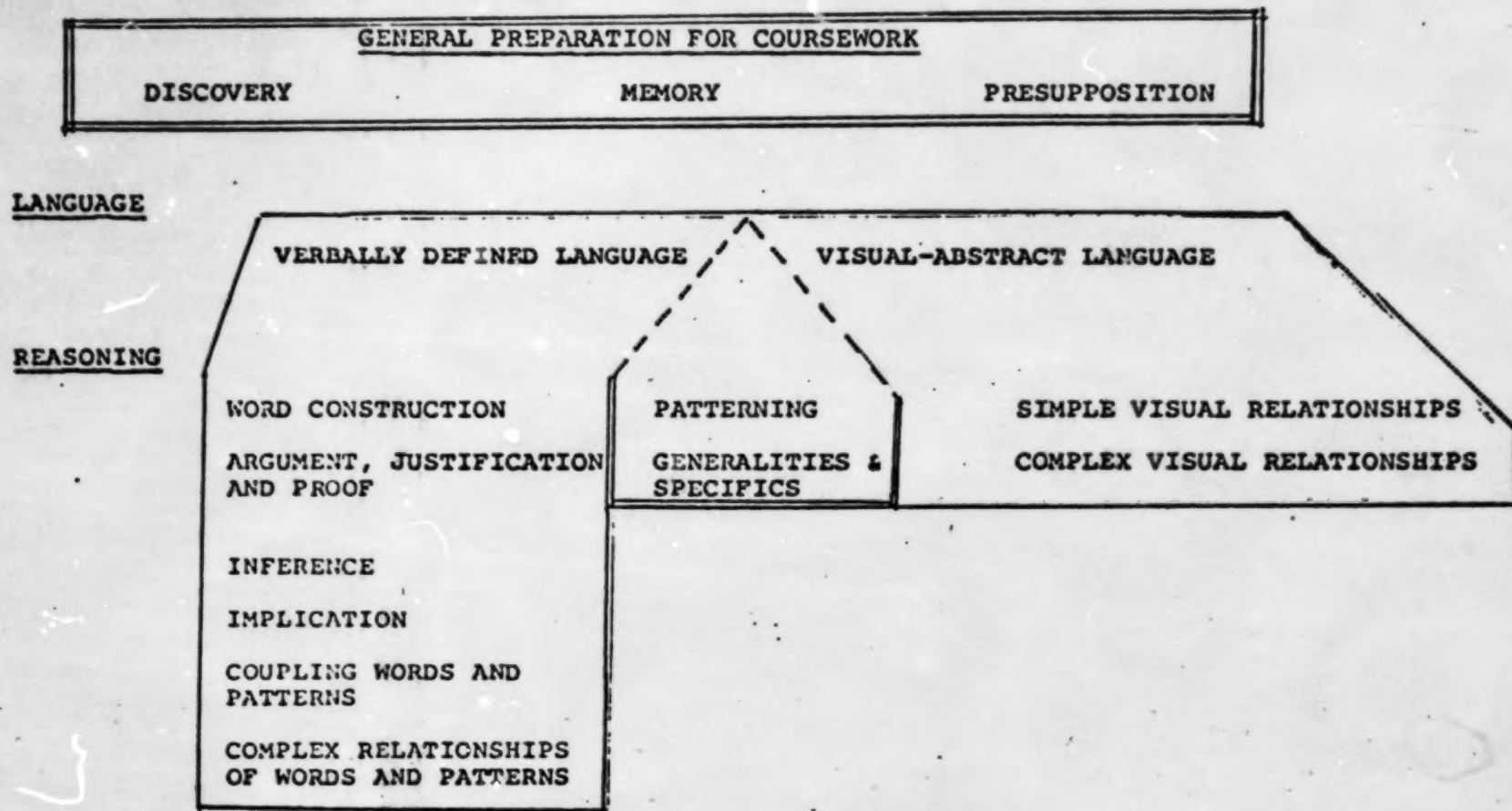


Table 3). If students receive less than 0.60 on a test section, the titles of the cognitive skill remedial programs associated with that section are listed on the printout generated by the grading program. The printout containing the test sections and the assigned cognitive skill remedial programs is used in conference to establish an agreement with the student on the semester's work.

Objective 3. To design and produce audio-tutorial programs to remediate the cognitive skills.

Objective 4. To design computer tests to determine the degree of acquisition of these skills.

Remedial programs were designed for each of the empirically determined cognitive skill areas. The general pattern followed was that proposed by Gagne of presenting new information and linking it with formerly discussed information. An idea or technique of problem solving is introduced and several examples are given. The student is then asked to solve problems for which the solutions are given on subsequent slides and in subsequent discussion. Finally, the students are asked to solve problems for which no answers are discussed during the program.

Several of the programs are designed to encourage introspection rather than a specific problem solving technique. These programs attempt to raise the learning process to a conscious level.

The cognitive skill programs, under the category headings of the cognitive model, are as follows:

I. Verbally Defined Language

This category of the language section of the cognitive model is associated with three programs for remediation; Verbally Defined Language, Search Process for Words and Word Construction.

Verbally Defined Language

This program introduces the student to the idea of defining words in terms of other words. One of the key ideas presented is that a meaningful definition must be one for which the individual understands all of the component words. This is coupled with the idea that understanding is based upon experience. Once a word has been defined, it becomes part of the experience base and may be used in defining other words.

Search Process for Words

The Search Process for Words program provides the opportunity for the student to examine him/herself and the way in which he/she approaches words. A major component of the program is to raise consciousness.

Word Construction

The Word Construction program deals with roots, prefixes and suffixes in a standard fashion. Since the program involves elementary features of critical observation and logic, it may be misplaced. Students, however, can generally perform the requisites for this program after completing the first two in the series.

II. Visual-Abstract Language

The other category under the general heading of Language is Visual-Abstract Language. This major category includes three programs for remediation; Visual Language, Abstract Language and Simple Visual Relationships.

Visual Language

The Visual Language program is without doubt the most elementary program in the collection. Students who have difficulty with this program, in fact, cannot be helped by the project resources. The program asks the student to create mental images from memories and progresses to critical observation of elementary objects and finally to identifying objects in simple labelled diagrams. Essentially, the student is asked to associate words with images, an ability that is associated with the transition from pre-verbal to verbal stages of development.

Abstract Language

This program deals with the concept of abstraction. Students are frequently spooked when they see word diagrams or mathematical problems with symbols. The program introduces them to alphabet letters as symbols with agreed upon configurations and phonetic associations through the use of codes, and to numbers as symbols with agreed upon meanings through the use of counting objects.

Simple Visual Relationships

Simple Visual Relationships is a program in the elements of critical observation. The program deals with analysis of structure and distinguishes between the whole and its parts.

III. Pattern Recognition

Pattern Recognition, a statistically derived category under the general heading of Reasoning, includes six cognitive skill remedial areas: Elementary Sorting Processes, Elements of Discovery, Search Process for Patterns, Systematic Sorting Processes, Complex Visual Relationships and Coupling Words and Patterns.

Elementary Sorting Processes

The first in the series is designed to prepare the student for examining patterns by having him/her learn something about his/her own way of viewing the world. After examining different types of memories (experiences, sensory images, information, emotions and processes), students are asked to explore the trigger mechanisms for recall. In essence, this is a program for memory, one of the cognitive skills considered as a foundation for all coursework.

Elements of Discovery

Discovery, the internalization of information and the openness to deal with newly presented information, is perceived as prerequisite for all learning. The program is a simple one, dealing with building self-confidence based on discoveries the students have already made. During the program, anagram games are played to see old information in new contexts. Basically, the program is an attempt to convince the student that an essential part of the learning process is to "discover" new information rather than just to memorize it.

Search Process for Patterns

The Search Process for Patterns program deals with perception of simple repeated patterns, simple relationship patterns, patterns of complex relationships and situations in which there are no patterns. The patterns used are abstract symbols and no verbal patterns are included at this time.

Systematic Sorting Processes

Systematic Sorting Processes introduces the student to problem solving through pattern recognition. Students are first shown how to approach some simple arithmetic and mathematical problems by examining components and sorting out the features. The program makes a transition to word problems with arithmetic overtones to introduce the student to patterns in verbal contexts.

Complex Visual Relationships

In this program the student is asked to deal with complex static figures and discern subtle relationships.

The program progresses to visual patterns and logic problems with visual components.

Coupling Words and Patterns

The final program in the series completes the transition to verbally defined language. The program consists of patterns that involve word meanings and several riddles are included.

IV. Classification and Elementary Logic

The second category under the Reasoning heading includes five cognitive skill programs; Generalities and Specifics, Recognition of Argument, Justification and Proof, Identification of Inference, Recognition of Presupposition and Recognition of Implication.

Generalities and Specifics

The information in this program is at the very heart of classification. Students are introduced to the concept of inclusive categories through visual, then verbal and then abstract means. The program begins with an examination of paintings by Van Gogh and Serat to show how different specific brush strokes lead to the creation of the painting. Taking from this example, an outline of classification of techniques in oil painting is generated in verbal form. The general discussion is used as a jumping off point to give some elementary information on deductive and inductive reasoning.

Recognition of Argument, Justification and Proof

The next program in the series introduces the student to the concept of an argument as opposed to a simple statement. The program progresses to obtaining logical conclusions from appropriate premises and is essentially an introduction to logic.

Identification of Inference

An inference is defined for the student as being like an argument in which one or more of the premises is a belief, probability or assumption. Thus, the conclusion of an inference is a logically drawn opinion. Students are shown the difference between an inference and an argument and are given information with which to form their own opinions.

This program has been, perhaps, the least successful of those tested to date. Either students are very reticent about writing down their opinions or the students we see are not used to making opinions. More work will have to be done to determine the cause before the program can be changed to accommodate the need.

Recognition of Presupposition

Presupposition of knowledge is considered to be another of the prerequisites for general learning, but the program was placed in this position in the sequence because it was felt that the student could assimilate the information best at this point. The object of the program is to convince the student that information is to be built upon. The program shows the student how to determine that a presupposition is being made, how to identify the specific presupposition and then how to locate the presupposed information.

Recognition of Implication

Here the student is introduced to the idea that in a logical progression toward an argument or an inference, one or more of the premises or a conclusion may never be stated. The student is taught to recognize an implication and fill in the missing premises or conclusions in arguments and logical progressions.

V. Logical Interaction

The third and final category under the heading of Reasoning has two cognitive skill programs; Complex Relationships of Words and Patterns and Diagram, Flow Chart and Graph Interpretation.

Complex Relationships of Words and Patterns

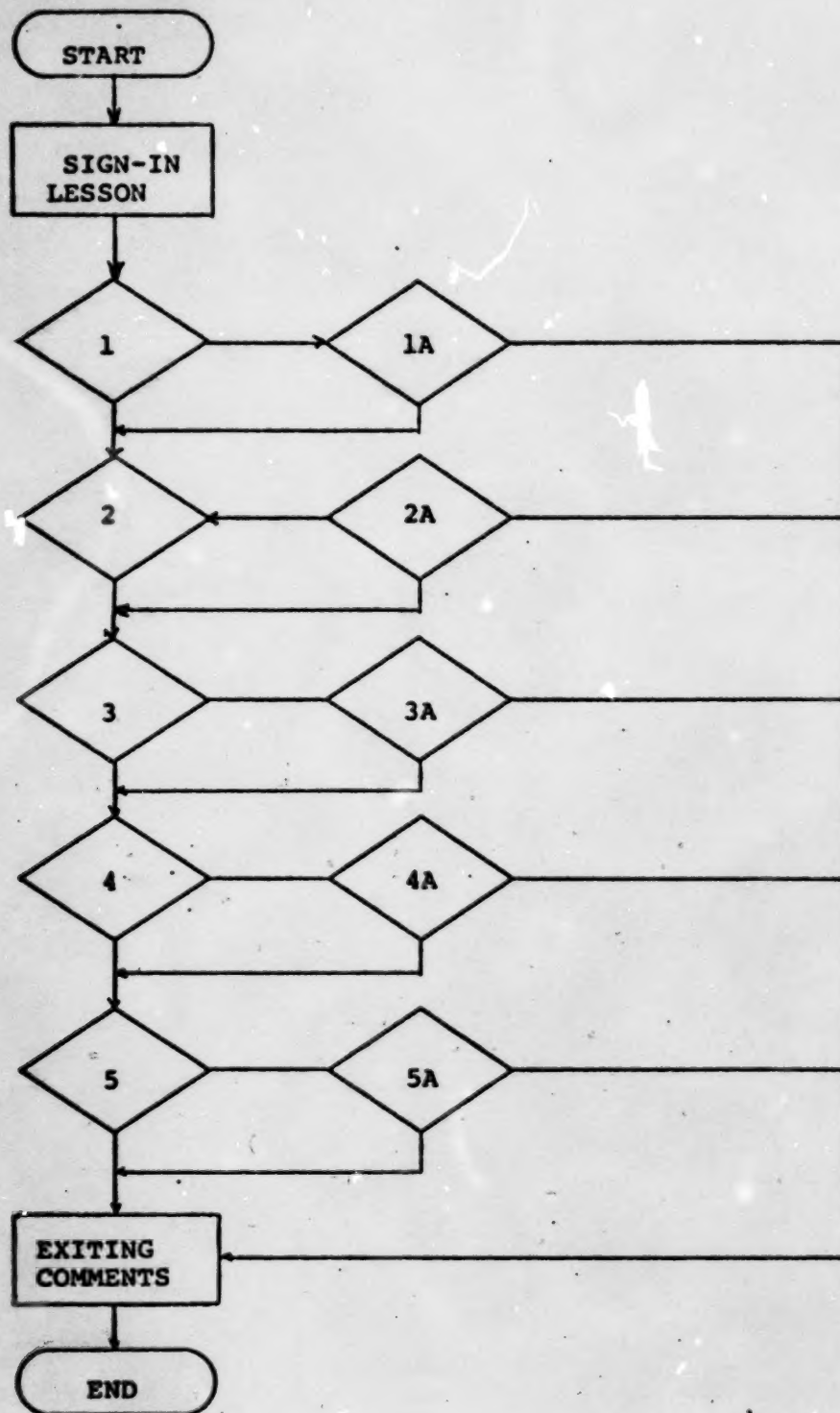
This program looks at the more subtle meanings of words by examining some Haiku poetry and asking the student to analyze poems and excerpts from novels. The program develops the idea of context clues for information, supposition, conditionality, causation and analogy.

Diagram, Flow Chart and Graph Interpretation

This program extends visual interpretation into graphed representations and into shorthand means of note-taking through simple diagrams and flow charts. Simple diagrams are interpreted and then word descriptions are given to show the student how to construct labelled diagrams. The process is repeated with flow charts and graphs.

Each of the cognitive skill remedial programs is coupled with a computer test for the acquisition of the skill. (The general pattern for the computer program for the tests is given in Fig. 1).

Fig. 1 Model of Computer Program for Computer Based Tests.



Objective 5. To design diagnostic tests for basic biological, chemical and mathematical information requisite for respective freshman level courses.

Objective 6. To design audio-tutorial programs for basic biological and chemical information.

Objective 7. To design computer programs for basic arithmetic information.

Biology -

A list of biological perspectives requisite for the freshman level course was determined by examining inclusive topics (see Table 4). The list became the basis for the Diagnostic Test for Basic Biology and for the design of the audio-tutorial programs.

At present, the test is given primarily to students enrolled in Anatomy and Physiology classes preparing to enter the nursing program. These students are assigned appropriate programs on the basis of the results on the various sections of the test.

The work on the cognitive skill areas became so overwhelming, and as previously mentioned, was so underestimated, that there has not been time to carry out the elaborate development of a validated test.

Chemistry -

The prerequisite information necessary for freshman level chemistry had been determined prior to the onset of the project, and this information has been taught in a Developmental Chemistry course (DRE 016). Ms. Patricia McCoy, who developed the course, designed and produced the audio-tutorial programs for each topic (see Table 5). These programs serve to reinforce lecture material and are extensively used by students enrolled in this course.

Rather than design a diagnostic test for chemistry when an acceptable one was found to be on the market, Ms. McCoy decided to use the Toledo Placement Test during the project. The results, however, have not been as predictive of student success as desired, and the Toledo Placement test was not used this year.

Mathematics -

The project experienced a change in personnel in the mathematics area. Ms. Marilyn Foulke was the initial mathematics resource person, and before leaving the college, completed the computer programs assigned (see Table 6). These have been used by students enrolled in the developmental course for mathematics.

Table 4. Basic Biology Programs

Introduction to the Concept of Levels of Order
Introduction to Atoms
Introduction to Molecules
Introduction to Macromolecules
Introduction to Organelles, Cells and Tissues
Introduction to Organs and Systems
Introduction to Animals
Introduction to Plants
Introduction to Unicellular Systems
Introduction to Life Processes
Introduction to Respiration
Introduction to Transport
Introduction to Excretion
Introduction to Reproduction

Table 5. Basic Chemistry Programs

Metric System
Other Units of Measurement
Mole Concept
Gram Molecular Weight, Percentage Composition and
Empirical Formulas
Balancing Equations
Weight-Weight Problems
Atomic Structure I
Periodic Table
Atomic Structure II
Atomic Structure III
Ion Formation and Ionic Bonding
Oxidation States
Nomenclature
Formula Writing
Solutions and Ionization
Acids, Bases I - Neutralization
pH and Logarithms
Acids and Bases II
Gas Laws
Covalent Bonding I
Electron Dot Formulas
Covalent Bonding II

Table 6. Arithmetic Computer Programs

Drill in adding positive whole numbers
Drill in subtracting positive whole numbers
Drill in multiplying positive whole numbers
Drill in Dividing positive whole numbers
Timed drill: Four arithmetic operations using positive whole numbers
Drill on addition of simple fractions
Drill on addition of signed (positive and negative) numbers
Drill on subtraction of signed numbers
Drill on multiplication of signed numbers
Drill on division of signed numbers
Timed Drill on division of signed numbers
Mixed Drill: Four operations using signed numbers
Drill on raising positive and negative integers to powers from two to four
Multiplication using negative and zero exponents
Rational Exponents: Raising both positive and negative integers to fractional exponents
Raising integers to positive, negative and zero exponents
Practice in "order of operations", computations involving the four operations, exponents and grouping symbols
Drill in multiplying binomials
Drill in factoring trinomials
Practice in Algebraic substitutions: Replacing variables in algebraic expressions with signed numbers
Solving systems of linear equations; Five with two equations, Five with three equations
Practice in factoring quadratics; Multiple choice
Four programs in one, offering the student the choice between practice in finding slopes of lines, midpoint, distance between two points, point-slope form equation or all four
Finding roots of quadratics: Quadratic equations that can be solved by factoring method
Solving linear equations of increasing difficulty
Quizzes in addition, subtraction, multiplication and division of positive and negative integers and in using exponents

Ms. Foulke also prepared a diagnostic mathematics test that was used at student orientation for entering freshman. The test was used for several years, but there were some problems with the placement results. With Ms. Foulke no longer at the college to further develop and improve the test, it was abandoned in favor of a self-assessment.

Ms. Bobbye Cabell replaced Ms. Foulke in administering the mathematics programs.

Objective 8. To design and produce audio-tutorial programs for course level information in introductory biology and chemistry courses.

Biology

Each topic in the freshman level biology course was produced in audio-tutorial form (see Table 7) and computer programs were designed to test the acquisition of information. Because of the number of topics involved, the task was monumental.

Students in introductory biology classes are encouraged to view the programs and check their understanding by taking the computer tests. Few students, however, avail themselves of this opportunity, except for material that is particularly conceptually difficult (e.g. Levels of Protein Structure, Cell Respiration, Protein Synthesis). One can only conclude that the time, effort and money put into this part of the project was largely wasted. (It should be mentioned that reviews of the material shown at the Midwest Biology Teachers meetings have been laudatory and many requests for programs received thus far have been primarily for the biology section.

Chemistry

The year the project went into effect, Charles Merrill Inc. Columbus, Ohio, published audio-tutorial chemistry programs suitable for the freshman level course. Rather than "reinvent the wheel", these tapes and workbooks were purchased.

The experience with the chemistry audio-tutorial programs has been similar to that with the biology programs. Only the tapes covering difficult conceptual material are used regularly.

Objective 9. To open a Natural Science Learning Laboratory in which the project would operate.

The Natural Science Learning Laboratory opened in Fall, 1976 in Room 408 of the Hartford Building of Jefferson Community College.

TABLE 7

Course-Level Biology Programs

Origin of Science
Origin of Physics
History of Chemistry
Domain of Science
Philosophical Basis of Science
Complementary of Structure and Function
Cell Theory
Natural Selection
Scientific Method
Electron Configuration
Chemical Bonding
Acids, Bases and Buffers
Organic Radicals and Linkages
Carbohydrates
Amino Acids, Polypeptides and Proteins
Lipids
Molecular Basis of Structure
Levels of Protein Structure
Enzyme Reactions
Energy and Living Systems
Synthesis of ATP
General Considerations of Glucose Breakdown
Fermentation
Glycolysis
Respiration as a Source of Monomers
Kreb's Cycle: General Pathway and Consequences
Kreb's Cycle: Specific Reactions
Energy Balance Sheet: Aerobic and Anaerobic Organisms
Waste Products in Respiration
Properties of Light and Chlorophyll
Photosynthesis: Light Reactions
Photosynthesis: Dark Reactions
Carbon Cycle
Modern View of a Eucaryotic Cell
Structure and Function of the Unit Membrane
The Cell as a Living Unit
The Concept of Genetic Material
The Hershey-Chase Experiment
The Watson-Crick Model of DNA
Cellular Events of Protein Synthesis
Coding Events of Protein Synthesis
Mitosis
Meiosis
Cytokinesis
Modes of Reproduction
The Mammalian Male Reproductive System
The Mammalian Female Reproductive System
Plant Fertilization and Development
Development of Animal Embryo
Methods of Birth Control

Operation of the Natural Science Learning Laboratory

The Natural Science Learning Laboratory serves both students who are enrolled for credit and walk-in students. (The University of Kentucky Community College System granted the Natural Science Learning Laboratory one developmental, nontransferable credit). Students are introduced to the personnel and facility as a class group. This is the first and last time they will be considered as a single unit.

At the next class period, students are given the Cognitive Diagnostic Test. Student answers are entered by hand into terminals linked to a Hewlett Packard Model 2000 C which has been programed in BASIC for grading and record keeping. The grading program generates a long form printout that gives the major areas of the test, the number of answers correct divided by the number of questions in the section and the frequency value (see Table 8). These long form printouts are used for student conferences to establish the work the student is expected to accomplish on cognitive skill remediation.

Students begin progressing through the assigned programs by the third class meeting. After the student has completed the audio-tutorial portion of a program, he/she brings the study guide to be checked. Master copies of the study guides are kept in notebooks and either the coordinator or the laboratory assistants can check it with the student. The time becomes a planned intervention during which the student interacts with the laboratory personnel.

If the work on the study guide indicates comprehension of the skill has not been achieved, the student may be asked to go over the material with the instructor or to take the audio-tutorial program again. If the work on the study guide indicates comprehension of the skill, the student progresses on to the next component, either a game or to the computer based test.

Commercially available games are used to reinforce cognitive skill remediation. After completing Search Process for Words, the students play Password. For Visual Language and Simple Visual Relationships, Jigsaw puzzles are used. Students play Yahtzee for Search Process for Patterns, and Master Mind and Deduction for Recognition of Argument, Justification and Proof.

After playing the games the students progress to the computer based test. Once they have completed the test, they file the study guide and test printout in their folders. An instructor must sign the Diagnostic long form printout before filing, and this provides another opportunity for positive interaction.

Table 8. Example of Long Form Printout
 JANE DOE Student Number 880001.

NOSCI-N0013

Verbally Defined Language 7 / 23 .304348

VDL

SPW

WC

Visual Abstract Language 3 / 21 .142857

VL

AL

SVR

PATTERN RECOGNITION 7 / 26 .269231

ESP

ED

SPP

SSP

CVR

CWP

CLASSIFI. & ELEM. LOGIC 6 / 14 .428571

GS

RAJP

IT

RP

RI

Logical Interaction 5 / 10 .5

CRWP

DFGI

000000000001100001100000000010110001000110

AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA

TOTAL SCORE .25641

Personnel of the Natural Science Learning Laboratory

During the first two years of the operation of the Learning Laboratory, it was staffed with laboratory assistants who had completed their undergraduate work. Since the Summer, 1978, however, the laboratory has been staffed with Mrs. Dorothy Lockhart, who serves as Natural Science Learning Laboratory Coordinator (and has a degree in special education) and work-study students from the college.

Each of the work-study students has been through training sessions to acquaint them with the operation of the center and the role they are to play (see Enclosure B). In some cases these assistants have been able to play a role equal to that of an instructor and can completely operate the facility. In other cases, the assistants are restricted to peripheral features of the operation, such as entering data on the computer and helping students with the equipment, to free the coordinator for work with individual students.

Objective 10. To keep student records and analyze data generated to judge the efficacy of testing and remediation programs.

During the two and one half years of operation, 3,124 student clock hours have been recorded. The efficacy of the remedial programs has been tested by using the Cognitive Diagnostic Test as a pre-test to determine needs and as a post-test to determine the degree of remediation of those needs. (It should be remembered that the students are not primed for answering specific questions on the test. Only the reasoning processes are the same, and in many cases, the reasoning processes required for answering the test questions use different combinations of skills than those practiced during the specific programs).

The data shows that students generally improve about 20% on each section (see Table 9). The greatest percentage of students improved on the Verbally Defined Language and the Pattern Recognition subcategories, and the least improved on the Logical Interaction section of the test.

The Cognitive Diagnostic Test

The data on the Cognitive Diagnostic Test was derived from a number of classes in different courses. Requests were sent to instructors throughout the college to administer the proposed test to their classes. At the end of the semester, final grades received by students in these classes were added to the data bank. A Spearman correlation coefficient analysis was done with respect to question groups and final grade in coursework for each course (see Table 10).

Table 9. Improvement as Demonstrated by Comparison of Pre-Post Test Results

Category	# students	# students improved	% students improved	Avg. # Ques. improved	% Questions improved
Verbally Defined Language	43	38	88.4%	4.57	13.4%
Visual-Abstract Language	54	47	87.0%	4.19	19.95%
Pattern Recognition	41	37	90.24%	4.54	20.63%
Classification and Elementary Logic	54	46	85.2%	3.24	18.0%
Logical Interaction	59	43	72.8%	2.97	21.2%

Table 10. Correlation Coefficients* of question groups and final grades

Course significance	n	Group I Verbally Defined Language	Group II Visual-Abstract Language	Group III Pattern Recognition	Group IV Classification & Reasoning	Group V Logical Interaction
Education	21	0.2831 0.107	0.3811 0.044	0.3643 0.052	0.3698 0.049	0.3094 0.086
Biology (Instructor A)	34	0.5783 0.001	0.7340 0.001	0.7839 0.001	0.6502 0.001	0.6475 0.001
Biology (Instructor B)	57	0.6379 0.001	0.6153 0.001	0.7210 0.001	0.7392 0.001	0.6604 0.001
Biology (Instructor C)	30	0.2213 0.124	0.1223 0.264	0.2762 0.073	0.4442 0.008	0.2266 0.119
Economics	46	0.3234 0.014	0.3277 0.013	0.3629 0.007	0.2874 0.026	0.3541 0.008
English Composition	30	0.4999 0.002	0.5423 0.001	0.5784 0.001	0.5560 0.001	0.4705 0.001
Intro. to Business	98	0.5493 0.001	0.3641 0.001	0.4378 0.001	0.4131 0.001	0.4409 0.001
Mathematics (Developmental)	36	0.5861 0.001	0.6068 0.001	0.6207 0.001	0.5873 0.001	0.7500 0.001
Mathematics (Inter. Alg.)	13	0.3743 0.104	0.3148 0.147	0.4776 0.049	0.3985 0.089	0.3562 0.116
Chemistry (Developmental)	23	0.5214 0.005	0.3191 0.069	0.3664 0.043	0.5252 0.005	0.0727 0.371
Chemistry (General)	23	0.3448 0.054	0.2579 0.117	0.4830 0.010	0.3567 0.047	0.3843 0.035

The grade correlations with question groups may be reflective of the style of instruction rather than of the subject matter. Among the three biology instructors, each emphasizes a unique pattern of communication and reasoning processes. The lower correlation coefficients for Instructor C may reflect this instructor's practice of curving grades or that this instructor, unlike the others, does not deal with thinking as an explicit learning objective. An inquiry of the instructors of these courses indicated that the higher correlations were in classes where criterion referenced testing and contract or contract-like grading systems are used, and in which thinking processes are utilized in explicit ways.

The Cognitive Diagnostic Test was also administered to fifty-five students from the Special Services Program under a Title IV grant. These students exhibit reading levels between 8th and 10th grades. Reading scores on some of the other students were also available. This permitted correlation coefficients to be determined between reading scores and question groups, and in some cases, between reading scores and final grades (see Tables 11 and 12).

Examination of the correlation coefficients of the reading scores with the question groups indicate a lower relationship than had been anticipated. These correlations are as good, however, if not better than those found between different reading tests.

Correlations between reading scores and grades for all students for whom reading scores were available ($n = 98$) was 0.4485. Unfortunately, the number of students with available reading scores in several classes was too low to arrive at any meaningful conclusion. (It should be noted that the presence of reading scores is nonrandom. About 65% of the students who enter the college attend the freshman orientation at which the reading tests are given. These students are generally more motivated and willing to prepare for their college careers). The Cognitive Diagnostic Test appears to correlate more highly with successful completion of course work, in many cases, than does the reading score.

The Cognitive Diagnostic Test developed during the project appears to serve as an excellent predictor for success in college level courses, particularly those classes where instructors use criterion referenced testing and/or teach thinking as an explicit learning objective.

Table 11. Correlation Coefficients* of Question groups, reading scores and Final Grades

Corr. Coef. (n) sign.	Group I Verbally Defined Language	Group II Visual Abstract Language	Group III Pattern Recognition	Group IV Classification & Reasoning	Group V Logical Interaction
Reading Scores**	0.4090 (163) 0.001	0.4208 (163) 0.001	0.4790 (163) 0.001	0.5254 (163) 0.001	0.4473 (163) 0.001
Final Grades	0.5102 (417) 0.001	0.5122 (417) 0.001	0.5697 (417) 0.001	0.5492 (417) 0.001	0.5235 (417) 0.001

* Pearson Correlation Coefficients

** McGraw Hill Reading Test

Table 12. Correlation Coefficients between Reading Scores and Grades

Course n significance	Correlation Coefficient Reading Score vs Final Grade
Introduction to Business	0.2919 (35) 0.044
Developmental Mathematics	0.2955 (29) 0.060
Overall	0.4485 (98)* 0.001

*the thirty-four remaining students for whom reading score data was available were distributed among the other classes. Each class had too small a sample to report, although correlation coefficients with these small groups were higher than those reported here.

Objective 11. To disseminate the information and materials from the project.

Dissemination of Materials

Requests for the materials were obtained from persons reading the Resources for Change published by F.I.P.S.E. and from individuals encountered at various meetings attended by the project personnel. To date, the Cognitive Diagnostic Test, grading procedures, rational for validation of the test, the Cognitive Skill Remedial Programs, the Basic Biology Programs, the Basic Chemistry Programs and/or the Course Level Biology programs have been sent to forty-eight colleges and universities. (See Enclosure C).

Videotaped Workshop

In lieu of the more standard type of workshop, the Fund suggested that the workshop information be recorded on videotape and sent to colleges requesting further information about the project. The resulting workshop is composed of four videotapes and is designed to run for a full day with group discussions after each of the taped presentations.

The taped sessions are as follows:

- I. Philosophical Basis of Cognitive Skill Remediation
- II. A Cognitive Diagnostic Test
- III. The Cognitive Remedial Programs
- IV. The Operation of the Natural Science Learning Laboratory

The workshop tapes are accompanied by a series of suggested materials (See Enclosure D).

Arrangements have been made through the Jefferson Community College Department of Continuing Education to grant Continuing Education Units for attendance at the workshop.

SUMMARY

The Multilevel Remediation project in Biology, Chemistry and Mathematics operated at Jefferson Community College for three years. In that time a cognitive model was proposed for cognitive skills requisite for success in freshman level courses. The cognitive model and test to determine cognitive skill levels has been successfully tested and the project continues under institutional support.

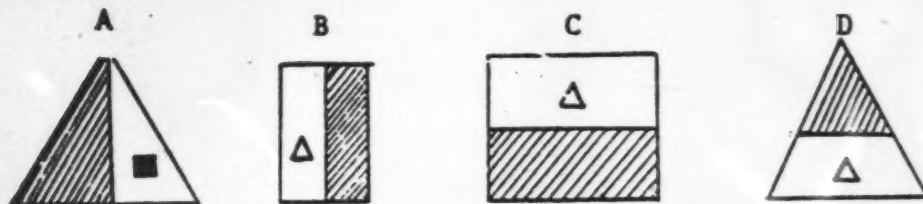
Enclosure A

**A Cognitive Diagnostic
Test Packet**

COGNITIVE DIAGNOSTIC TEST

ANSWER THE FOLLOWING QUESTIONS BY PLACING THE CORRECT LETTER, NUMBER OR WORD IN THE BLANK ON THE ANSWER SHEET. YOU MAY USE SCRATCH PAPER. DO NOT WRITE ON THIS EXAMINATION COPY.

1. There is a figure that is divided in half by a vertical line (a line that runs up and down.) On the left side of the line is a triangle. The right side is shaded. Which of the figures pictured below is described?



2. The word is inundate. Inundate means flood, ~~overwhelm~~, to surround and enter every opening. Which picture below best illustrates the word inundate?



3. The next three letters in this sequence would be:

o x X O o x X O o x X O o x X _ _ _

- (a) O X X
(b) O, x X
(c) x o X
(d) O o x

4. What letters are missing?

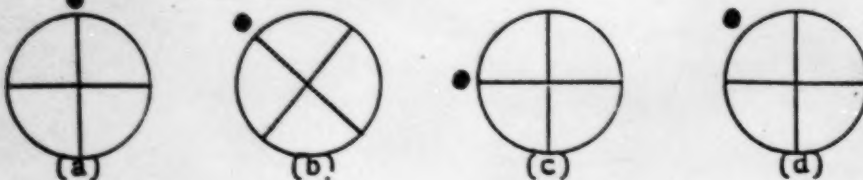
rEprE- - - - AtIvE

- (a) Sent
(b) sEnt
(c) seNt
(d) sent

5. The following figure is undergoing a pattern of changes?



What is the next position the figure will assume?



6. What letters are missing?

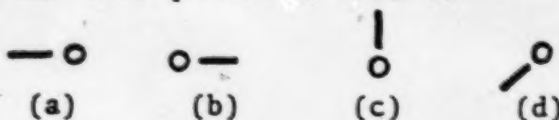
aRT- - - iC

- A. isT
- B. Ist
- C. iSt
- D. iST

7. The following figure is undergoing a series of changes.



The next position will be



8. The following is a code.

A = +
B = *
C = |
D = #
E = +
F = *
G = |
H = #
I = +
J = *
K = |
L = #

The word PLUS spelled in the code would be:

- A. # * | #
- B. * # | |
- C. | * * +
- D. # # * |

3000 (A)
3000 (B)
3000 (C)
3000 (D)

9. The relationship of paint to canvas is the same as the relationship of:

- (a) artist to art
- (b) linament to skin
- (c) chair to room
- (d) cigarette to ashtray

10. The relationship of vase to table is the same as the relationship of:

- (a) rug to floor
- (b) letter to envelope
- (c) tree to lawn
- (d) smoke to chimney

11. The relationship of fertilizer to growth is the same as the relationship of:

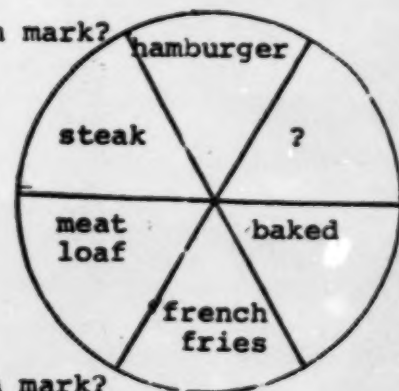
- (a) light to reading
- (b) pillow to bed
- (c) photosynthesis to green
- (d) minerals to sickness

12. The year after Harvey and Joanne married, Barbara was born to them. Twenty years later, Barbara married Phil, and within a year, they became parents of Michael. A year later, Harvey and Joanne had another child, Paula. What is the relationship of Paula to Michael?

- (a) an aunt
- (b) a cousin
- (c) a sister
- (d) an uncle

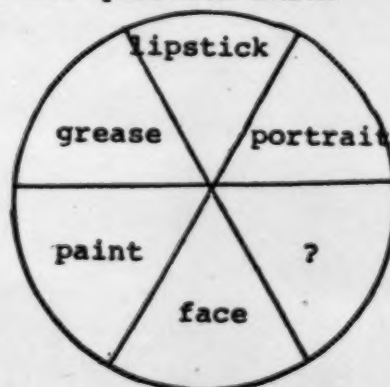
13. What should be in the section with the question mark?

- (a) chopped beef
- (b) string beans
- (c) mashed potatoes
- (d) salad



14. What should be in the section with the question mark?

- (a) skyscraper
- (b) engine
- (c) feet
- (d) table



15. Read the following sentence carefully.

The gribnots frockled in the duesbur, molicking their gimlots and cragling their henprel molocons.

The word in the sentence that might mean river would be:

- (a) gribnots
- (b) gimlots
- (c) duesbur
- (d) molocons

16. The word in the sentence given in question 15 that might mean washed is:

- (a) gimlots
- (b) frockled
- (c) molocons
- (d) duesbur

17. The word in the sentence given in question 15 that might mean hair is:

- (a) molocons
- (b) duesbur
- (c) cragling
- (d) gribnots

18. Given the terms window, pillow, feather and wall, two are categories that include the other two as subcategories. The two subcategories are:

- (a) window and feather
- (b) window and pillow
- (c) feather and wall
- (d) window and wall

19. Given the terms word, leaf, page, plant, two are categories that include the other two as subcategories. The two subcategories are:

- (a) leaf and page
- (b) word and page
- (c) page and plant
- (d) word and leaf

20. Given the terms square, corner, petals, flower, two are categories that include the other two as subcategories. The two subcategories are:

- (a) corner and flower
- (b) square and flower
- (c) flower and petals
- (d) corner and petals

21. pattern, phone number, memorize, polka-dot

Two of the above words are categories in which the other words would be subcategories. The subcategories are:

- (a) pattern, memorize
- (b) phone number, polka-dot
- (c) memorize, polka-dot
- (d) phone number, memorize

22. $a + b = b + a$; $a - b \neq b - a$; $3 + 2 = 2 + 3$; $7 - 5 \neq 5 - 7$

The two that are parts of the whole are:

- (a) $a + b = b + a$; $a - b \neq b - a$
 - (b) $3 + 2 = 2 + 3$; $7 - 5 \neq 5 - 7$
 - (c) $a + b = b + a$; $3 + 2 = 2 + 3$
 - (d) $a \times b = b \times a$; $3 \times 2 = 2 \times 3$
- (Note: The symbol $\neq$ means "does not equal")

23. $\frac{x}{y} = 3$; $\frac{6}{2} = 3$; $xy = 12$; $6 \times 2 = 12$

The two that are parts of the whole are:

- (a) $\frac{x}{y} = 3$; $6 \times 2 = 12$
- (b) $xy = 12$; $6 \times 2 = 12$
- (c) $\frac{6}{2} = 3$; $\frac{x}{y} = 3$
- (d) $\frac{6}{2} = 3$; $6 \times 2 = 12$

24. $a \times b = b \times a$, therefore, which of the following follows logically?

- (a) $\frac{b}{a} \neq \frac{a}{b}$
- (b) $17 \times 2 = 2 \times 17$
- (c) $17 + 2 = 2 + 17$
- (d) $8 \times 2 = 4 \times 4$

25. All planets of this solar system can be seen with a telescope. Mercury is a planet, therefore:

- (a) It is closer to Earth than Mars.
- (b) It can be seen with a telescope.
- (c) It has the same temperature as Earth.
- (d) It is possible for a spaceship to get to Mercury.

26. $\frac{8}{2} \neq \frac{2}{8}$; $\frac{6}{3} \neq \frac{3}{6}$, Therefore:

(a) $a \times b = b \times a$

(b) $\frac{4}{2} \neq \frac{2}{4}$

(c) $\frac{12}{3} \neq \frac{6}{3}$

(d) $\frac{a}{b} \neq \frac{b}{a}$

27. The relationship of light to room is the same as the relationship as

- (a) water to lake
- (b) man to house
- (c) ashes to fireplace
- (d) food to table

28. Read the following section:

When a seed is viable it means that it will germinate or start to grow. I know that these seeds are viable because I planted them and they all grew into separate, healthy plants.

Which of the following statements is the evidence for the conclusion?

- (a) These seeds are viable.
- (b) Viable means "ability to grow"
- (c) These seeds germinated
- (s) The plants are healthy

29. Which of the statements in question number 28 is the conclusion that the evidence proves?

30. Sam and Charlie each have a dog and a house. The one who has the large dog lives in a small house. The large house is painted green. Charlie lives in a white house.

Which statement below is correct?

- (a) Charlie has a large dog.
- (b) Sam lives in the small house.
- (c) Charlie has a small dog.
- (d) Charlie lives alone.

31. If I had watered this plant and put it in the light it wouldn't have died.

From this statement you know:

- (a) The plant wasn't watered.
- (b) The plant was neither watered nor kept in the light.
- (c) The plant was either not watered or not kept in the light.
- (d) Water and /or light were not given to the plant.

32. X = YB
Y = O
B = GGG

Another way of writing XY is:

- (a) XGGG
- (b) OGGGO
- (c) OGGGX
- (d) YBGGG

33. Y = XOX
X = BB
O = YOO

Another way of writing YBB is:

- (a) YOBBX ●
- (b) BBOOYX ●
- (c) BBYOXX ●
- (d) YXXX ●

34. O = GB
X = YY
Y = BG

Another way of writing OYYX is:

- (a) GBBGYYY
- (b) YGG
- (c) GBYYXO
- (d) BGGBYXO

35. Emma Thompson is a member of the South Holyoke Baptist Church. She attends church every Sunday, the Sewing Bee on Wednesday afternoons and the Ladies Guild on Fridays. Each year she helps to prepare the Christmas baskets for the orphanage.

Which of the following is implied in this passage?

- (a) Emma Thompson is a devout Baptist.
- (b) Emma Thompson believes in God.
- (c) Emma Thompson is a hard working member of her church.
- (d) All of Emma Thompson's time and efforts are put into church.

36. $a = b$; $b = c$; therefore:

- (a) $a + c = b$
- (b) $a = c$
- (c) $a + b = c$
- (d) $b - a = c$

37. Most plants are green. Green plants can undergo photosynthesis. Therefore:

- (a) Photosynthesis is a chemical process.
- (b) Green plants are photosynthetic.
- (c) Most plants are photosynthetic.
- (d) Green plants are undergoing a chemical process.

38. $a = b$; $b = c$; therefore:

(a) $a + b = b + c$

(b) $a - b = c$

(c) $a - c = b$

(d) $c - a = b$

39. $a = b$; $b = c$, therefore

(a) $\frac{a}{b} = \frac{c}{b} = 1$

(b) $\frac{a}{c} = \frac{c}{b} = 2$

(c) $\frac{c}{a} = \frac{b}{a} = 0$

(d) $a = b = c = 3$

40. Write a word that can be made from the letters S Y E E.

Master Answer Sheet

Answer Sheet

Diagnostic Cog. (40)

1. B

2. C

3. D

4. B

5. D

6. D

7. B

8. D

9. B

10. C

11. A

12. A

13. C

14. B

15. C

16. B

17. A

18. A

19. D

20. D

21. B

22. B

23. D

24. B

25. B

26. D

27. A

28. C

29. A

30. A

31. D

32. B

33. C

34. A

35. C

36. B

37. C

38. A

39. A

40. EYES

Answer Sheet

- | | |
|-----------|-----------|
| 1. _____ | 21. _____ |
| 2. _____ | 22. _____ |
| 3. _____ | 23. _____ |
| 4. _____ | 24. _____ |
| 5. _____ | 25. _____ |
| 6. _____ | 26. _____ |
| 7. _____ | 27. _____ |
| 8. _____ | 28. _____ |
| 9. _____ | 29. _____ |
| 10. _____ | 30. _____ |
| 11. _____ | 31. _____ |
| 12. _____ | 32. _____ |
| 13. _____ | 33. _____ |
| 14. _____ | 34. _____ |
| 15. _____ | 35. _____ |
| 16. _____ | 36. _____ |
| 17. _____ | 37. _____ |
| 18. _____ | 38. _____ |
| 19. _____ | 39. _____ |
| 20. _____ | 40. _____ |

SCORING FORMAT

based on

Spearman Rho & Kuder-Richardson Data

Verbally Defined Language

2, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20,
21, 25, 27, 28, 29, 30, 31, 35, 37, 40

Visual Abstract Language

2, 3, 4, 5, 6, 7, 8, 13, 14, 22, 23, 24, 26, 32, 33,
34, 35, 36, 38, 39, 40

Pattern Recognition

2, 4, 5, 6, 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20,
24, 26, 28, 29, 30, 32, 35, 36, 37, 38, 39

Classification and Elementary Logic

2, 5, 7, 8, 11, 12, 13, 14, 18, 19, 20, 30, 34, 35, 38

Logical Interaction

23, 29, 30, 32, 33, 34, 36, 38, 39, 40

ENCLOSURE B

PROGRAM CHECKLIST

Please Check the Programs You would Like to Receive:

DIAGNOSTIC TEST

COGNITIVE PROGRAMS (Total-17)

BASIC BIOLOGY PROGRAMS (Total-14)

Introduction to the Concept of Levels
Introduction to Atoms
Introduction to Molecules
Introduction to Macromolecules
Introduction to Organelles, Cells and Tissues
Introduction to Organs and Systems
Introduction to Animals
Introduction to Plants
Introduction to Unicellular Systems
Introduction to Life Processes
Introduction to Respiration
Introduction to Transport
Introduction to Excretion
Introduction to Reproduction
ALL OF THE ABOVE BASIC BIOLOGY PROGRAMS

ADVANCED BIOLOGY PROGRAMS (Total-51)

Origin of Science
Origin of Physics
History of Chemistry
Domain of Science
Philosophical Basis of Science
Complementary of Structure and Function
Cell Theory
Natural Selection
Scientific Method
Electron Configuration
Chemical Bonding
Acids, Bases and Buffers
Organic Radicals and Linkages
Carbohydrates
Amino Acids, Polypeptides and Proteins
Lipids
Molecular Basis of Structure
Levels of Protein Structure
Enzyme Reactions
Energy and Living Systems
Synthesis of ATP

General Considerations of Glucose Breakdown

Fermentation

Glycolysis

Respiration as a Source of Monomers

Kreb's Cycle: General Pathway and Consequences

Kreb's Cycle: Specific Reactions

Energy Balance Sheet: Aerobic and Anaerobic Organisms

Waste Products in Respiration

Properties of Light and Chlorophyll

Photosynthesis: Light Reactions

Photosynthesis: Dark Reactions

Carbon Cycle

Modern View of a Eucaryotic Cell

Structure and Function of the Unit Membrane

The Cell as a Living Unit

The Concept of Genetic Material

The Hershey-Chase Experiment

The Watson-Crick Model of DNA

Cellular Events of Protein Synthesis

Coding Events of Protein Synthesis

Mitosis

Meiosis

Cytokinesis

Modes of Reproduction

The Mammalian Male Reproductive System

The Mammalian Female Reproductive System

Plant Fertilization and Development

Development of Animal Embryo

Methods of Birth Control

ALL OF THE ABOVE ADVANCED BIOLOGY PROGRAMS

BASIC CHEMISTRY (Total-22)

Metric System

Other Units of Measurements

Mole Concept

Gram Molecular Weight, Percentage Composition and

Empirical Formulas

Balancing Equations

Weight-Weight Problems

Atomic Structure I

Periodic Table

Atomic Structure II

Atomic Structure III

Ion Formation and Ionic Bonding

Oxidation States

Nomenclature

Formula Writing

Solutions and Ionization

Acids, Bases & Neutralization

PI and Logarithms (112 only)

Acids and Bases II (112 only)

Gas Laws

_____	Covalent Bonding I
_____	Electron Dot Formulas
_____	Covalent Bonding II
_____	:
_____	ALL OF THE ABOVE CHEMISTRY PROGRAMS

Enclosure C
Interview Techniques

INTERVIEW TECHNIQUES

General Considerations:

1. As an interviewer, you are in a position of authority. The authority should be used wisely. Remember, you are there to help.
2. You will be in close physical contact with the students you interview. Your personal grooming must not detract from the interviewing process.
3. The relationships established during the interviews will probably last throughout the semester. Keep in mind that these are students you will see over and over again and work toward establishing lasting relationships with them.

I. Personal Grooming

A. Cleanliness of body

Body odor can be distracting in the interview situation. Please bathe regularly and keep perfumes to a minimum.

B. Cleanliness of clothes

Clothes can pick up body odors when worn over again. Please wear clean clothes when dealing with students in interview situations.

C. Dress code

There is no official dress code for work-study students in the NSLL. Any clothes that would be acceptable in the classroom or are socially acceptable to your peers is acceptable in the NSLL.

II. Interviewing

A. A student entering NSLL

1. Introduce yourself
2. Ask the student's name
Throughout the interview continue to use the student's name
3. Ask the student appropriate questions to obtain the following information:
 - a. Classes in which student is enrolled
 - b. Instructor or situation referring student to NSLL
 - c. Goals of the student in NSLL
If goals are not clearly defined, aim of the interview becomes goal establishment.
4. Explain the NSLL to student
5. Establish specific goals (cognitive remediation, background biology, chemistry, mathematics, and/or course level biology, chemistry and mathematics) with the student

6. Outline the program the student is to undertake in the NSLL, including tests, programs and post tests.

B. Conference after Diagnostic Cognitive Test

1. Introduce yourself
2. Ask the student's name
(Unless you remember the student from a previous interview and know his/her name) Use the student's name throughout the remainder of the interview.
3. Explain the Diagnostic Cognitive Test to the student, emphasizing
 - a. The DCT is not a test for intelligence, it is a test for determining how people handle information.
 - b. The DCT is designed to help, not to criticize a person.
4. Go over each area of the DCT
 - a. Verbally Defined Language:
Associating the meaning of words
(Most students will do OK on this part of the test. Be sure to compliment them on it)
 - b. Visual-Abstract Language
Associating ideas in the form of mental images.
 - c. Pattern Recognition
Determining relationships between pieces of information
 - d. Part-Whole Relationships
Categorizing or classifying information
 - e. Logical Interaction
Using Patterns and classifications to generate new information in the form of conclusions.
5. Show the student that each of the major areas is associated with specific programs.
- *6. Outline the programs the student is to take to improve in each area.
 - a. Introduce the student to the caramate
 - b. Show student the games they will be expected to play
 - c. Introduce the student to the computer terminal
7. Ask if there are any questions, and answer any questions the student asks
8. Assure the student that you will be available to help them throughout his/her time in the NSLL.

*If the student seems overwhelmed, this step can be left until the next time the student is in the NSLL.

ENCLOSURE D

COGNITIVE SKILL REMEDIATION

VIDEOTAPED WORKSHOP

COGNITIVE SKILL REMEDIATION WORKSHOP

The Cognitive Skill Remediation Workshop consists of four videotaped presentations, each followed by a planned discussion of the information and/or attitudes presented in the videotaped sessions. The videotaped portion of the workshop includes:

- I. Philosophical Basis of Cognitive Skill Remediation**
- II. A Cognitive Diagnostic Test**
- III. The Cognitive Skill Remedial Programs**
- IV. The Operation of the Natural Science Learning Laboratory**

Although the listing is in the preferred order, workshop directors may choose to present the information in the manner they deem most suitable for their viewing audience.

The heart of the workshop is the discussion that follows each presentation. The nature of the discussion will depend upon the size of the viewing audience and their degree of sensitivity with respect to nontraditional students. If the faculty/staff viewing the workshop have not participated extensively in faculty development programs designed to sensitize them toward the needs of nontraditional students, the discussion following each workshop presentation is best kept general, with an emphasis on philosophy of education at the particular institution. In other words, the goal of the Cognitive Skill Remediation Workshop might be to sensitize the college personnel. If the faculty has participated in faculty development programs of the aforementioned nature, the discussion can become quite specific. In this case, faculty members of similar disciplines can meet in small groups to discuss specific topics and reasoning processes in light of their already determined philosophy of education. For these faculty members, the goal of the workshop would be to explore some concrete means by which reasoning processes can be dealt with in the classroom situation.

The following are suggestions for workshop discussions following the videotaped presentation (based on a workshop attendance of more than fourteen persons):

I. Philosophical Basis of Cognitive Remediation

A. For Sensitizing

- 1. Small groups (5 - 7 members) composed of faculty from different disciplines. Discussion centered around long range goals for students and faculty accountability.**

2. Group leaders should be faculty and/or staff who have had experience dealing with nontraditional students, particularly in a study skills center environment.

B. Intermediate

1. Small groups (5 - 7 members) composed of faculty from different disciplines. Discussion centered around long range goals of students and ways in which movement toward these goals can be augmented in the classroom situation.
2. Group leaders may be faculty and/or staff who have had experience dealing with nontraditional students in classroom situations.

C. Advanced

1. Small groups (5 - 7 members) composed of faculty from the same or similar disciplines. Discussion is a sharing of the means by which long range goals are dealt with by various members of the group in the classroom.
2. Group leader may be a volunteer from the group itself, either previously assigned or selected at the start of the workshop discussion.

II. A Cognitive Diagnostic Test

- A. For Sensitizing
B. Intermediate
C. Advanced

Large Group Discussion of

1. Maintaining standards in college level courses for nontraditional students.
2. Explicit means of teaching reasoning skills. (This may take the form of summing up for the earlier, small group discussions).
3. The potential use of an instrument, such as that proposed in the workshop, for assessing students at orientation sessions or in individual classrooms.
4. Cognitively defining the difference between secondary and postsecondary courses.

(The discussion might center around one, some or all of the above).

III. The Cognitive Skill Remedial Programs

A. For Sensitizing

1. Small groups (5 - 7 members) of faculty from the same or similar disciplines. Discussion centered around selecting the most difficulty topic in respective courses and an attempt to analyze the reasoning skills involved in mastering the information (according to the cognitive model described in the workshop).
2. Group leaders may be the same as before, or a counselor unfamiliar with the discipline.

B. Intermediate

1. Small groups (5 - 7 members) of faculty from the same or similar disciplines. Discussion centered around selecting a single topic with which all are familiar and analyzing the reasoning skills involved in mastery (according to the cognitive model described in the workshop). This may be followed by an extension of the previous discussion on the means by which the reasoning skills can be explicitly handled in the classroom situation.
2. Groups leaders may be the same as before, or a counselor unfamiliar with the discipline.

C. Advanced.

1. Small groups (5 - 7 members) of faculty from different disciplines. Discussion centered around means by which reasoning skills are explicitly handled in the classroom.
2. Group leaders may be a volunteer from the group itself, either previously assigned or selected at the start of the workshop discussion.

IV. The Operation of the Natural Science Learning Laboratory

- A. For Sensitizing**
- B. Intermediate**
- C. Advanced**

Large Group Discussion on

1. Operation of a Learning Laboratory for nontraditional students.
2. Concern for the affective domain of the student in the classroom.

3. The use of "planned intervention" in individualized instruction.

4. The use of peer tutors in a Learning Laboratory.

(The discussion might center around one, some or all of the above).

REGARDLESS OF THE FORMAT, WE STRONGLY SUGGEST THAT THE COMMENTS OF EACH SMALL GROUP BE COLLECTED, EDITED AND DISTRIBUTED TO BOTH PARTICIPATING AND NON-PARTICIPATING FACULTY. (We have followed this practice at Jefferson Community College, and have found it to be invaluable in stimulating thought and carrying the ideas of any workshop toward meaningful change).

AT THE END OF THE WORKSHOP, PLEASE ASK PARTICIPANTS TO FILL
IN THE ENCLOSED EVALUATION FORM. PLEASE SEND COMPLETED
EVALUATION FORMS TO

Ellen Korn
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